PULP & PAPER

September 1999

ENGINEERING

RECYCLING

North American Mills Begin New Era

Volume 64
Number 9

SEPTEMBER

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This issue's 23-article special engineering report examines the economics of recycling in North American pulp and paper mills and takes a closeup look at the latest techniques and equipment being used to collect, sort, and process wastepaper for use in all grades of paper and board. **(Cover art by Rick Eberly.)**

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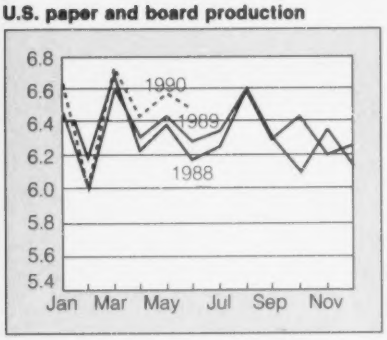
ABP

BPA

U.S. paper and board production



U.S. production of paper and paperboard totaled 6.5 million tons in June, up 2.2% from a year earlier, according to the American Paper Institute. The seasonally adjusted annual rate of production climbed to 77.8 million tpy for the first half, up 1.7% from June 1989. Second-quarter production in 1990 was 1% higher than the first quarter of the year and 2.5% higher than second-quarter 1989.

Among major grades, healthy growth in newsprint continued to lead the way, but most other paper grades showed strength as well. Printing and writing shipments were up 2.8% from June 1989, as new and unfilled orders surged dramatically for coated paper and uncoated free-sheet.

Containerboard was up 1.1% through June, thanks to a 13.4% increase in production for export. A 20.0% increase in boxboard production for export was offset by a 1.5% decline for the domestic market.

Canadian newsprint shipments totaled 804,000 metric tons in June, down 0.6% from a year earlier, while mill operating rates held steady at 95%. Woodpulp shipments plunged to 615,000 tons, down 13.4% from June 1989. Pulp mills operated at 82% of capacity in June, down from 93% a year earlier. ■

	Latest month (000 short tons)		% change from year ago	Annualized year-to-date (000 short tons)	% change from year ago
PAPER & PAPERBOARD PRODUCTION[1]					
Newsprint	June	539	8.2	6,462	8.9
Uncoated groundwood (s)	June	145	4.3	1,785	4.0
Coated paper (s)	June	603	4.0	7,255	3.5
Uncoated free-sheet (s)	June	910	2.7	11,454	2.4
Other printing/writing	June	135	3.1	1,617	6.7
Total packaging and other paper (s)	June	394	-1.7	4,676	-4.0
Tissue	June	479	2.1	5,729	2.4
Total paper	**June**	**3,205**	**3.3**	**38,978**	**2.8**
Unbleached kraft paperboard	June	1,681	2.4	19,859	1.9
Semichemical medium	June	467	-0.2	5,675	-0.3
Bleached paperboard	June	376	-4.6	4,499	0.3
Recycled paperboard	June	738	2.8	8,806	-1.2
Total paperboard	**June**	**3,262**	**1.2**	**38,839**	**0.7**
Total U.S. paper and paperboard output	**June**	**6,467**	**2.2**	**77,817**	**1.7**
PULP, WASTEPAPER & FIBER[2]					
Total U.S. woodpulp production	May	5,164	1.5	62,778	1.2
Market pulp production	May	698	-3.2	8,503	-3.6
Wastepaper consumption at paper/board mills	May	1,799	10.8	20,945	5.8
Pulpwood consumption (cords)	May	8,113	0.0	99,300	2.1
CONVERTED PRODUCTS STATISTICS[3]					
Corrugated box shipments (billion ft²)	June	26.265	-1.8	158.704[6]	0.5
Containerboard inventories at U.S. box plants and mills	June	12,542	1.9		
INTERNATIONAL TRADE[2]					
U.S. paper imports (including products)	May	1,064	1.6	13,268	2.3
Imports of Canadian newsprint	May	717	-0.8	8,507[6]	2.1
U.S. paper exports (including products)	May	547	-7.4	6,816	7.2
Exports of unbleached kraft linerboard	May	202	-12.9	2,631	11.1
Exports of woodpulp	May	443	-12.1	5,733	-8.7
Norscan pulp inventories[4]	June 30	1,397	80.7		
Norscan pulp operating rates[4]	June	86%	87%	85%	89%
CANADIAN STATISTICS[5] *(reported in metric tons)*					
Total newsprint shipments	June	804	-0.6	4,738[6]	0.7
Operating rates	June	95%	95%	95%	97%
Inventories held by U.S. consumers	June 30	1,308	0.6		
Other paper/board shipments	June	615	9.8	3,675	7.5
Woodpulp shipments (export only)	June	651	-13.4	3,807	-9.9
Operating rates	June	82%	93%	87%	94%

1. American Paper Institute. 2. API, Bureau of Census, American Pulpwood Assn. 3. Fibre Box Assn., Paperboard Packaging Council. 4. North American/Scandinavian paper-grade market pulp. 5. Canadian Pulp & Paper Assn. 6. Not annualized. (s) = Shipments.

Uncoated groundwood: Uncertain economy may weaken various primary markets

Grade structure: Uncoated groundwood paper has physical properties similar to newsprint but sustains higher brightness levels and smoother surfaces. Gloss added by supercalendering allows high-end uncoated groundwood paper to compete with lightweight coated (LWC) groundwood paper. Brightness levels range from 64 to 74 Elrephro, compared with 56 to 62 for standard newsprint and 68 to 84 for LWC. Basis weights range from 20 to 45 lb/3,300 ft². Primary uses for uncoated groundwood paper include preprinted newspaper inserts and direct mail flyers, catalogs, lower-cost business forms, Sunday newspaper magazines, and telephone directories.

Production/capacity: Groundwood paper production in North America has continued to grow in the past few years, mostly in supercalendered (SC) and directory grades. Conversion of newsprint machines to make groundwood specialties has continued, prompted, in part, by newsprint overcapacity. U.S. mills shipped 1.754 million tons in 1989, up 8% from 1988. Canadian uncoated groundwood shipments rose 9% to 1.611 million metric tons in 1989, about 80% sent to the U.S.

Groundwood paper capacity in North America is continuing to rise. Canadian uncoated groundwood capacity increased 14.3% in 1989 to 1.776 million metric tpy. Another 7.6% increase is expected this year. U.S. mill capacity rose 6.4% in 1989 to 1.846 million short tpy but is expected to decline 2.1% in 1990 to 1.808 million tpy.

Some recent and future projects are St. Marys Paper Inc., Sault Ste. Marie, Ont. (131,000 short tpy, 1988); Lake Superior Paper Industries (245,000 short tpy); Stone-Consolidated Inc., Grand Mère, Que. (110,000 short-tpy net, 1989); and Kruger Inc., Corner Brook, Nfld. (70,000 metric tpy conversion). Daishowa America Co. has delayed a new 150,000-tpy directory paper machine in Port Angeles, Wash.

Outlook: Demand growth rates are estimated at 4.1%/year through 1999. End-use demand will stay relatively healthy for the remainder of the 1990s. Oversupply in Europe will continue to affect pricing in North America.

Telephone directories should average about 2% to 4%/year for the decade. Some consolidation in the directory publishing industry should continue, but the number of pages should rise.

SC paper could corner 84% of the catalog paper market by 1998. But machine-finished grades will lose market share in this category. Consumption of groundwood paper for catalogs may rise about 0.15%/year through 1993. Overall demand for SC paper is advancing 8% to 10%/year.

Paper for business forms will advance by about 7.5%/year through 1993, while stationery and tablets will gain only 1.6% annually.

Groundwood consumption for preprinted advertising inserts is expected to grow almost 6.5% annually, while other forms of commercial printing may consume 3.5% more paper each year.

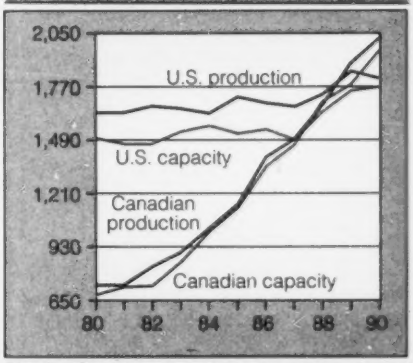
Magazine publishers and printers are likely to use about 2.8%/year more uncoated groundwood paper, shifting from lower grades to SC.

Uncoated groundwood paper for books is likely to drop 0.9% annually through 1993.

Prices: Price increases on most grades were announced in 1990 after a rough year or so of price pressure. Not among those grades hiked was premium SC, which follows LWC rather than the rest of the uncoated groundwood market. Most grades were still being discounted from list though demand stayed relatively strong.

Year-end list prices for 34-lb supercalendered ($/short ton) are: 1987, $704; 1988, $830; 1989, $830; 1990, $830; mid-year 1990, $830, but discounted $20-$30/ton. Prices for 35-lb offset, 65 brightness are: 1987, $565; 1988, $675; 1989, $655; mid-year 1990, $655, but discounted $20/ton. For standard 30-lb rotonews: 1987, $541; 1988, $650; 1989, $650; mid-year 1990, $680, discounted to $650. For 15-lb, 65 brightness forms: 1987, $560; 1988, $720; 1989, $700; mid-year 1990, $615.

SUPPLY/DEMAND (000 tons)



FORECAST (000 tons)

U.S.	1990e	1989	1988r
Production	1,765	1,754	1,624
Capacity[1]	1,808	1,846	1,735
Utilization rate	97.6%	95.0%	93.6%
Imports	1,552	1,470	1,404
Exports	90	71	24.01
Apparent U.S. consumption	3,227	2,153	2,962
lb/capita	25.77	25.30	24.01
000 tons/$ billion real GNP (1982)	0.76	0.76	0.74
Canada[2]			
Production	1,971	1,776	1,628
Capacity	2,027	1,884	1,648
Exports	1,695	1,527	1,382
Utilization rate	97.2%	94.3%	98.8%

e = *Pulp & Paper* 1990 estimate. r = Revised.
1. American Paper Institute.
2. Canadian Pulp & Paper Assn. Capacity probably understated by at least 200,000 tons.

TOP NORTH AMERICAN PRODUCERS

	Annual capacity (000 short tpy)	Market share (%)
1. Abitibi-Price	525	14.4
2. MacMillan Bloedel[1]	444	10.2
3. Canadian Pacific	430	9.9
4. Stone-Consolidated	423	9.7
5. Georgia-Pacific Corp.[2]	212	6.6
6. Boise Cascade	270	6.2
7. Lake Superior Paper	240	5.5
8. Champion International[3]	229	5.5
9. Domtar	190	4.4
10. St. Marys Paper	185	4.3
11. Madison Paper	175	4.0

Market share of top five companies: **53.7%**

Market share of top ten companies: **83.1%**

North American capacity (1990): **3,789 million tons**

U.S.: 1.762; Canada: 2.027[4]

1. MacMillan Bloedel & Fraser owned by Noranda Forest Inc. 2. (Great) Northern Paper Div., Millinocket, Maine. 3. 1989 production. 4. Customs clasification revisions will probably increase Canadian capacity by 200,000 or more.

SALES AND EARNINGS

U.S. paper profits tumble, Canada plummets

Despite higher production, U.S. paper industry profits continued to spiral downward in the second quarter due to lower prices for many grades. Second-quarter earnings declined 27% from a year ago, although sales increased 4.5%, according to a *Pulp & Paper Week* survey of 30 U.S. companies. While a few companies were able to buck the trend and post higher results, several large companies suffered earnings drops of 40% to 50% or more. Tissue producers were among the best performers in the U.S. and Canada, while companies with heavy exposure to newsprint, market pulp, and containerboard generally did the worst. Nevertheless, there were signs that the rapid slide in North American industry profits that gained momentum in fourth-quarter 1989 may be slowing down.

Printing and writing paper producers are being helped by stronger demand and a partial recovery in uncoated free-sheet prices. Newsprint may have bottomed out in the second quarter with the successful June price increase. And the linerboard market also has been showing signs of stability helped by steady domestic box cutup and strong export demand. As a result of this, a number of chief executives expressed at least guarded hope for the future. "We expect demand and operating rates to remain healthy in the months ahead," noted Eugene Cartlege, CEO of Union Camp Corp.

Georgia-Pacific Corp. said stronger sales from its building products and pulp and paper units plus higher prices for softwood lumber and structural panels mitigated a 38% drop in profits. But a tripling of interest expense to $185 million from $66 million in 1989 offset gains. Payments jumped due to the March takeover of Great Northern Nekoosa Corp. for $3.74 billion. Building product profits for the second quarter rose 12.7% to a record $159 million, while pulp/paper profits climbed 8.3% to $261 million.

"Compared to last year, earnings were lower due to price declines for uncoated printing and writing papers and containerboard," said John A. Georges, CEO of International Paper Co. "Our quarter-to-quarter improvement was due to strong performances by our European and specialty products businesses." Europe's economy is expanding at twice the rate of U.S. growth, Georges said, as he expressed "guarded optimism" for the third quarter.

Income from paper operations declined markedly for Boise Cascade Corp. as the company cited lower prices for most grades, especially newsprint and uncoated free-sheet. Stone Container Corp.'s profits plummeted primarily due to continued discounting of product pricing, increased interest expense, and higher tax rates, the company said. The inclusion of figures for Stone-Consolidated Inc. of Canada pushed up sales 3.6% in the second quarter and 15% for the first six months of 1990.

Champion International Corp. said nonrecurring items assisted income but only partially offset second-quarter production losses resulting from

U.S. paper/products industry results.

	Second-quarter 1990 ($000)			
Paper companies	**Sales 1990**	**% change**	**Earnings 1990[1]**	**% change**
Badger Paper	$19,495	−0.9%	$964	−19.7%
Boise Cascade Corp.	1,058,250	−3.9	23,030	−69.4
Bowater Inc.	342,333	−5.8	14,201	−62.6
Champion International Corp.	1,260,013	−2.3	63,469	−44.3
Chesapeake Corp.	222,774	4.4	7,502	−37.4
Consolidated	237,974	−0.2	38,072	−12.7
Federal Paper Board Co. Inc.	317,203	2.7	34,571	−32.7
Gaylord Container Corp.-3rd Q	172,200	−11.0	(6,900)	NM
Georgia-Pacific Corp.	3,519,000	33.3	107,000	−37.8
P.H. Glatfelter Co.	156,907	0.2	22,264	−10.4
International Paper Co.	3,200,000	6.7	185,000	−19.2
James River Corp. 5/23	1,522,113	−7.4	50,827	−31.6
Kimberly-Clark Corp.	1,612,700	15.5	80,400	−20.6
Longview Fiber Corp. 4/30	163,344	−3.1	15,538	0.4
Louisiana-Pacific Corp.	501,500	−4.7	38,000	−21.5
Mead Corp.	1,228,900	1.8	46,100	−26.4
Mosinee Paper Corp.	52,700	−9.7	3,184	−12.5
Pentair Inc.	294,924	−3.0	7,049	−31.8
Pope & Talbot Inc.	143,770	−10.4	8,577	−23.1
Potlatch Corp.	321,234	8.5	32,348	25.8
Scott Paper Co.	1,321,000	5.3	74,600	4.3
Sonoco Products Co.	420,725	1.3	27,554	−3.5
Stone Container Corp.	1,429,800	3.6	29,500	−53.6
St. Joe Paper Co.	148,241	−8.0	10,401	−38.3
Temple-Inland Inc.	587,400	20.1	65,700	24.2
Union Camp Corp.	715,058	0.5	58,430	−28.2
Wausau Paper Mills Co. 5/31	88,190	10.1	5,842	3.4
Westvaco Corp. 4/30	582,972	3.8	45,970	−21.0
Weyerhaeuser Co.	2,392,418	−9.5	114,256	−26.2
Willamette Industries Inc.	491,640	0.0	43,613	−7.4
Total	**$24,524,778**	**4.5%**	**$1,247,062**	**−26.9%**

1. Income after taxes, from continuing operations, excluding most significant nonrecurring items where possible. ( ) = losses.
2. **Kimberly-Clark:** Second-quarter 1990 income includes a net charge of $44 million related to pending sale of a Canadian subsidiary. **Pope & Talbot:** Second-quarter 1990 income includes gain of $1.5 million from sale of timberland. **Stone-Container:** Second-quarter 1990 income includes net gain of $3.1 million from sales of timberland. 1989 income includes $1.5-million gain from sale of assets. NM=not meaningful.

rebuilding and maintenance projects. The company saw a 44.3% plunge in income compared with 1989, suffering a sharp drop in earnings at its Brazilian subsidiary following radical economic reforms imposed by the new government.

Mead Corp. cited scattered operational problems at Escanaba, Mich., and Chillocothe, Ohio, mills that offset a strong performance by its Packaging & Paperboard Group, said CEO Burnell R. Roberts.

"The record level of earnings in the second quarter of 1990 is principally due to the impressive performance of Scott Worldwide's U.S. tissue business," said Scott Paper Co. CEO Philip E. Lippincott. He noted that the S.D. Warren Div. printing and publishing paper unit was improving but was performing below expectations. Scott posted a 4.3% gain in income from a year earlier, with a 5.3% increase in sales.

Canadian profits evaporate. Canada's pulp and paper industry ran closer to the break-even level in the second quarter as companies continued to reel from the rising value of the Canadian dollar, poor prices for newsprint, and sluggish demand for market pulp. A survey of 15 companies showed an aggregate profit of C$100 million for the second quarter of 1990, down 75% compared with industry earnings of C$400 million during the same period in 1989. But after adjusting for nonrecurring items, the group probably ran at much less profit as sales declined 3.7% from a year earlier. Most producers noted some improvement in newsprint shipments due to customer inventory building in anticipation of labor unrest and a recent newsprint price increase. But profits were hurt in the second quarter by heavy downtime at market pulp mills to reduce inventories and higher stumpage costs in British Columbia. The outlook for the Canadian industry remains gloomy for the third quarter, with market pulp prices starting to slide, further mill downtime (either planned or because of strikes), and the Canadian dollar still climbing.

Red ink flowed at Abitibi-Price Inc., which reported a loss of C$3.7 million. But excluding a charge of C$28.9 million for unusual items, which mostly involved the cost of staff reductions associated with the company's restructuring plans, the company posted after-tax earnings of C$14.1 million. "While the restructuring plan has had a markedly negative impact on 1990 earnings," said Abitibi-Price CEO Bernd K. Koken, "the long-term effect will be increased profitability."

Canadian Pacific Forest Products Ltd. cited weak markets in all business sectors except tissue products and losses at its two new joint-venture newsprint mills at Gold River, B.C., and Usk, Wash. MacMillan Bloedel Ltd. suffered a 58% decline in second-quarter earnings, citing higher costs, the stronger Canadian dollar, and market-related pulp mill downtime. In newsprint, the company noted, recent machine shutdowns and conversions have reduced industry oversupply, and the situation in this market "may not be as acute as originally anticipated."

Companies that bucked the trend included Fletcher Challenge Canada Ltd. and Scott Paper Ltd., which reported a 6% increase in profits for the second quarter due to healthy tissue demand that offset higher interest expenses incurred for a recent acquisition and improvements, including completion of a new recycled fiber plant at Crabtree, Que.

Costly environmental projects. As earnings fall, Canadian pulp mills must cope with expensive environmental rules, as Environment Canada works "madly" to finish studies necessary to develop federal limits on the release of chlorinated organic pollutants (AOX) in pulp mill effluent. These regulations will complement standards proposed earlier this year that cover conventional pulp and paper industry pollutants as well as dioxins and furans. The Canadian Pulp & Paper Assn. has estimated that the bill for this first set of regulations and some related improvements could reach C$5 billion.

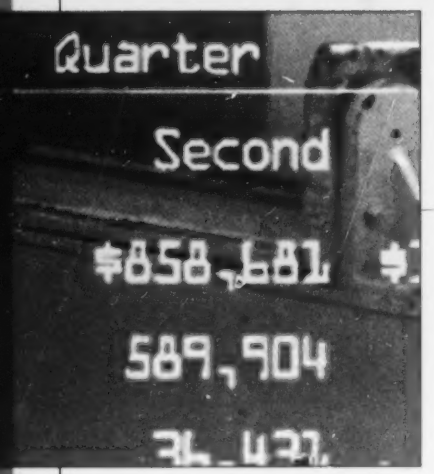
The industry outlook is not going to brighten any time soon. "Profits this year will continue to deteriorate, and next year will be just as difficult," said Brian Topp, forest product analyst with Capital Group Securities Ltd. "The industry will trim back all unnecessary capital expenditures" and may have to finance the essential projects through bank loans. Topp added that firms such as Noranda Forest Inc. and Domtar Inc. that already have heavy debt loads "will have to try and catch up in 1992-94, when they start to do better." ■

Canadian paper/products industry results.

	Second-quarter 1990 (C$000)			
Companies	**Sales 1990**	**Change 1990/89**	**Earnings 1990[1]**	**Change 1990/89**
Abitibi-Price Inc.	$803,100	−3.3%	$ (3,700)	NM
Canadian Pacific Forest Products Ltd.	650,600	−12.3	6,600	−90.9%
Canfor Corp.	236,700	6.5	30,500	18.7
Crestbrook Forest Industries Ltd.	56,709	−17.6	3,523	−61.2
Doman	150,885	84.9	2,916	−70.3
Domtar Inc.	608,000	−7.3	(29,000)	NM
Donohue Inc.	158,600	−5.7	5,900	−45.9
Fletcher Challenge Canada Ltd.	299,000	−18.3	37,000	15.6
MacMillan Bloedel Ltd.	806,900	−6.4	28,800	−57.8
Noranda Forest Inc.	1,228,000	−2.0	(4,000)	NM
Repap Enterprises Corp. Inc.	305,500	12.0	4,200	−81.0
Rolland Inc.	104,297	−9.2	(2,088)	NM
Scott Paper Ltd.	117,670	1.0	3,200	5.8
Tembec (3rd Q)	62,357	−5.3	4,539	−57.1
Weldwood	190,400	1.9	6,800	−57.5
West Fraser	149,400	−1.5	5,100	−28.2
Total	**$5,928,118**	**−3.7%**	**$100,290**	**−74.9%**

1. Income after taxes, from continuing operations, excluding most significant nonrecurring items in both years.
2. **Abitibi-Price:** 1990 income includes a C$28.9-million charge for unusual items, mostly the cost of staff reductions. **Canfor:** 1990 income includes a C$26.2 million after-tax gain from the sale of its High Level, Alta., sawmill division. **Domtar:** 1989 results restated to reflect discontinued operations. **Fletcher Challenge:** 1990 income includes an after-tax gain of C$20.7 million from the sale of its oriented strandboard plant in Minnesota.

( ) = losses. NM=Not meaningful.



Solid Waste Issue Creates Boom in Recycled Fiber Capacity Growth

Over half of proposed secondary fiber projects are new since last fall

By CARL ESPE, News Editor

Faced with a solid waste problem that threatens to grow to crisis proportions, more than a dozen states are considering or have already passed laws mandating increased use of recycled fiber in newsprint and other paper grades. This situation has led to a boom in secondary fiber expansion projects and proposals, as papermakers in the U.S. and Canada scramble to position themselves for what promises to be a very different market. The accompanying tables from *Pulp & Paper Project Report* describe over 60 projects, ranging from new deinking capacity for newsprint and tissue mills to wastepaper processing projects for containerboard and boxboard facilities. Several proposed market-deinked pulp facilities are also listed.

Illustrating the fast pace of change in this area, well over half of these projects are new since last fall. In addition, three major deinking plant installations and one new recycled newsprint mill that were listed as "proposed" last fall have now been approved: Bowater Southern, Calhoun, Tenn.; James River Corp., Halsey, Ore.; Daishowa Forest Products Ltd., Quebec City, Que.;

TABLE 2: **Wastepaper processing projects at Canadian mills.**

Start date	Cost ($ million)	Company, mill site	Additional information
Canada (C; short tons)			
none	—	Abitibi-Price Inc., undecided mill	Install deinking capacity to produce furnish for recycled newsprint
none	—	Alberta Newsprint, Whitecourt, Alta.	Considering 100,000-tpy deinking plant for recycled newsprint production
1990	—	Atlantic Packaging, Whitby, Ont.	New 200,000-tpy recycled tissue/newsprint mill
none	—	Boise Cascade Canada Ltd., Kenora, Ont.	Considering installation of a deinking plant to allow production of recycled newsprint
1991	175.0	Canadian Pacific Forest Products Ltd., Gatineau, Que. and Thunder Bay, Ont.	Install 500-tpd washing and flotation deinking line at Gatineau and 275-tpd line at Thunder Bay for recycled newsprint furnish
none	—	Cascades, Cap-de-la-Mad., Que.	Proposed 55,000-tpy deinked pulp plant; seeking provincial financing
1990	20.0	Cascades (East Angus) Inc., East Angus, Que.	Install 60-tpd deinking plant to allow use of higher wastepaper grades
1990	—	Cascades Inc. (E-P-C), Kingsey Falls, Que.	$30-million recycled tissue expansion includes a new deinking line
1992	56.0	Daishowa Forest Products Ltd., Quebec City, Que.	Install 300-tpd Japanese-technology deinking plant for newsprint/directory production
none	53.0	Kruger Inc., Bromptonville, Que.	Proposed 50,000-tpy deinking plant, with future increase to 150,000 tpy
1990	—	Lake Utopia Paper Ltd., St. George, N.B.	Install 235-tpd Black Clawson secondary fiber system at corrugating medium mill
none	—	Maclaren/Donohue, Montreal, Que.	Proposed joint-venture 85,000-tpy deinked pulp plant
1991	83.0	Newstech Recycling, Coquitlan, B.C.	122,500-tpy market deinked groundwood pulp mill; MacMillan Bloedel and Fletcher Challenge will each purchase half the output
none	100.0	Noranda Forest Inc., Thorold, Ont.	Studying new 272-tpd deinking plant to boost secondary fiber use
none	—	Orford Recycling, Drummondville, Que.	Proposed 120,000-tpy market deinked pulp mill
1991	45.0	Perkins Papers Ltd., Candiac, Que.	Tissue expansion with new paper machine and deinking line
1990	31.0	Scott Paper Ltd., Crabtree, Que.	Build new 65-tpd secondary fiber line; boosts recycled fiber capacity to 165 tpd
none	—	F.F. Soucy Inc. of Associes, Riviere-du-Loup, Que.	Install deinking facilities once a pattern of recycling laws and market needs is established
1991	—	Stone-Consolidated, Shawinigan, Que.	Install capacity for recycled newsprint by end of 1991

and Smurfit Newsprint Corp., northeastern U.S.

RECYCLED NEWSPRINT. While virgin newsprint is suffering the effects of overcapacity, there could be a shortage of recycled newsprint over the next few years. Virtually all North American newsprint producers that are not using any secondary fiber currently are seriously considering some type of expansion into recycled news-

TABLE 1: **Wastepaper processing projects at U.S. mills.**

Start date	Cost ($ million)	Company, mill site	Additional information
U.S. (US$; short tons)			
1991	55.6	Alabama River Pulp Co., Claiborne, Ala.	Install 110,000-tpy deinking plant to allow new mill to produce 40% recycled-content newsprint
1990	27.0	Augusta Newsprint Co., Augusta, Ga.	Replace stone groundwood pulp mill with new 250-metric-tpd deinking plant to process ONP and magazines
none	—	Bear Island Paper Co., Ashland, Va.	Install deinking for recycled newsprint; timing depends on state recycling laws and markets
none	60.0	Boise Cascade Corp., West Tacoma, Wash.	Looking for joint-venture partner to install deinking plant and convert mill to 40% recycled-content newsprint
1991	75.0	Bowater Southern, Calhoun, Tenn.	Build new 300-tpd, single-line deinking plant to allow production of 40% recycled-content newsprint
1992	85.0	Champion International., Sheldon, Texas	Build new 145,000-tpy deinking plant to allow production of recycled newsprint
1990	—	Chesapeake, Menasha, Wis.	New deinking line; part of $160-million expansion that includes new tissue machine
none	25.0	Daishowa America Co. Ltd., Port Angeles, Wash.	Considering 170-tpd deinking plant to process wastepaper for directory paper production
1992	200.0	Daishowa, Stockton, Calif.	New 350,000-tpy recycled containerboard mill; joint venture with Trans-Rim Enterprises
none	200.0	Dunkirk Containerbd., Dunkirk, N.Y.	Proposed new 250,000-tpy recycled containerboard mill
1991	125.0	Fort Howard Corp., Rincon, Ga.	Fiber processing expansion for fourth recycled tissue machine
1991	25.0	Fox River Fiber, Kaukauna, Wis.	Build new flotation deinking plant to produce 200 tpd of market recycled fiber
none	20.0	FSC Paper Co., Alsip, Ill.	Supplement washing system at recycled newsprint mill with flotation
1990	25.0	Georgia-Pacific Corp., Cedar Springs, Ga.	Linerboard expansion includes 15,000-tpy boost in recycled fiber usage
none	—	Georgia-Pacific Corp., East Millinocket, Maine	Seeking permits for deinking plant to produce recycled newsprint
1990	—	Gaylord Container Corp., Bogalusa, La.	Install 300-tpd double kraft liner recycling system from Black Clawson
none	—	Golden State, Pomona, Calif.	Studying addition of a new recycled newsprint machine, which would require additional deinking capacity
1990	—	Green Bay Packaging Inc., Morrilton, Ark.	Upgrade secondary fiber system for 350-tpd kraft linerboard expansion
none	—	Howard Paper Mills Inc., Urbana, Ohio	Exploring installation of deinking capacity, perhaps in a joint venture
1991	—	Inland Empire Paper Co., Millwood, Wash.	Install 108-tpd washing deinking system to allow production of 40% recycled-content newsprint
none	—	James River Corp., Green Bay, Wis.	Considering phaseout of sulfite mill and expansion of deinking capacity
1992	65.0	James River Corp., Helsey, Ore.	Build new 300-tpd secondary fiber plant to supply tissue and communication paper mills in Halsey, Clatskanie, Ore., and Camas, Wash.
none	—	Kimberly-Clark Corp., Coosa Pines, Ala.	Reportedly considering installation of deinking plant at newsprint mill
1991	—	MacMillan Bloedel Inc., Pine Hill, Ala.	$66-million containerboard mill uprade includes recycled fiber expansion
1990	—	Manistique Papers Inc., Manistique, Mich.	Install a second Voith deinking line to remove hotmelt glue from magazines
1990	—	Mead Coated Board Inc., Mahrt, Ala.	Recycled fiber system from Beloit Jones for new 366,000-tpy paperboard mill
1991	35.0	Menasha Corp., Otsego, Mich.	Corrugating medium expansion; includes new wastepaper processing system to expand secondary fiber usage
1990	66.0	Mi Ho Paper, St. Joseph, Mo.	New fine paper mill; furnish will be market pulp and recycled fiber
1991	—	North Pacific Paper Corp., Longview, Wash	New 165,000- to 180,000-tpy deinking plant to allow production of recycled newsprint
none	480.0	Northampton Pbd, Northampton, Pa.	Proposed 300,000-tpy recycled paperboard mill
1991	15.0	Patriot Paper, Hyde Park, Mass.	Restart idle white paper mill and rebuild deinking plant
none	200.0	Scott Paper Co., Indiana or Kentucky	Build new tissue mill, possibly with deinking capacity
none	—	Smurfit, Fernandina Beach, Fla.	Expand secondary fiber facilities for recycled containerboard machine restart; 1992 target
1990	—	Smurfit Newsprint Corp., Newberg, Ore.	Install flotation deinking to process magazine stock for newsprint furnish
none	—	Smurfit Newsprint Corp., northeast U.S.	New 255,000-metric-tpy recycled newsprint mill
1992	100.0	Stone Container Corp., Jacksonville, Fla.	Convert mill from kraft paper and linerboard to 100% recycled linerboard
1990	16.0	Stone Container Corp., Missoula, Mont.	Build new 144,000-tpy OCC processing plant to supply 20% to 25% of mill's fiber supply
1991	—	Stone Container Corp., Port Wentworth, Ga.	New Black Clawson secondary fiber system for $335-million mill modernization
1993	160.0	Temple-Inland Inc., Mayfield, Ky.	Probable site for new 600-tpd recycled containerboard mill
1990	35.0	Temple-Inland Inc., Newport, Ind.	Recycled medium expansion includes wastepaper plant upgrade
1991	30.0	Weston Paper & Manufacturing Co., Terre Haute, Ind.	Corrugating medium expansion includes OCC upgrade
none	19.0	Weyerhaeuser Paper Co., Springfield, Ore.	Proposed 400-tpd OCC processing system for linerboard mill; 1992 target

print—including those that are far away from wastepaper sources, such as Georgia-Pacific Corp.'s East Millinocket, Maine, mill. Canadian producers are in a particularly tight spot because they are building most of the virgin-pulp newsprint capacity in the current expansion boom, and they are poorly situated geographically to increase usage of recycled fiber because of their distance from metropolitan areas.

Southeast Paper's new 210,000-tpy recycled newsprint machine, started up in 1989, is the sole new newsprint machine among the current crop of expansions to produce recycled grades. Media General Inc.'s Garden State Paper Co. was considering a greenfield mill for the U.S. Northeast, where the landfill problem is most acute, but the project has been thrown into limbo by Media General's announcement that it will sell Garden State. Smurfit Newsprint has approved plans to build a new 255,000-metric-tpy recycled newsprint mill in the Northeast, but the company has not yet announced the location. New recycled paperboard mills have been proposed for the Northeast by Dunkirk Containerboard in New York and Northampton Paperboard in Pennsylvania.

On the West Coast, North Pacific Paper Corp. has approved a plan to install a new newsprint machine at Longview, Wash., that includes a deinking facility capable of supplying 25% of overall mill needs. Golden State Paper, which belonged to Garden State Paper until early 1989 and was recently sold to Jefferson Smurfit, is studying a new recycled newsprint machine for its Pomona, Calif., mill. Also in California, Daishowa and Trans-Rim Ltd. of Seattle have announced plans to build a recycled containerboard mill in Stockton with capacity for 350,000 tpy.

In eastern Canada, Abitibi-Price Inc., Boise Cascade Corp., Bowater, and Stone-Consolidated have all stated publicly that they are studying plans to incorporate secondary fiber in their newsprint operations. Donohue Inc. and James Maclaren Industries Inc. have proposed a joint-venture facility for Montreal, Que. Cascades Inc., Noranda Forest Inc., and Kruger Inc. are also considering deinking expansions. Atlantic Packaging will complete a new recycled newsprint and tissue mill this year in Whitby, Ont., and Daishowa Canada announced this summer that it will install a large deinking plant for recycled newsprint and directory paper production at its Quebec City, Que., mill. In western Canada, Fletcher Challenge Canada Ltd. and MacMillan Bloedel have agreed to take the output of a new market-deinked pulp plant to be built by Newstech Recycling Inc. in Coquitlam, B.C. There are currently no deinking facilities in western Canada. ■

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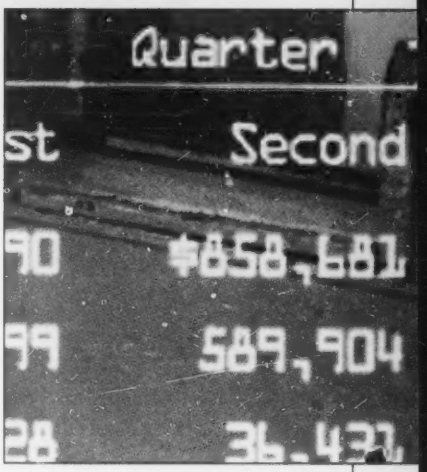


Grade-by-grade cost analysis shows various advantages, but savings depend on geographics, fiber availability, and desired product quality

By ARTHUR C. VEVERKA

Worldwide, nearly 75 million tons of recycled fiber were consumed by the paper industry in 1988, accounting for almost one-third of the total papermaking fiber needs of the industry. North America and Western Europe (as a whole) each consumed some 20 million tons of wastepaper in 1988, followed by Japan with a consumption of 12.5 million tons. These three regions accounted for about 70% of the total worldwide use of recycled fiber.

During the period 1970 to 1988, the demand for recycled fiber grew twice as fast as the demand for virgin pulp on a worldwide basis (Figure 1). This growth amounted to 5%/year for recycled fiber vs 2.5%/year for virgin fiber. It appears the use of recycled fiber will continue to grow even more rapidly in the future.

By 1996, consumption of wastepaper is expected to have passed the 100-million-ton mark and to reach 130 million tons by 2001. With the assumption of an average growth rate of 2.6%/year in global consumption and production of paper and board products, the worldwide recycled fiber utilization rate is expected to increase from 32.8% in 1988 to 41% in 2001.

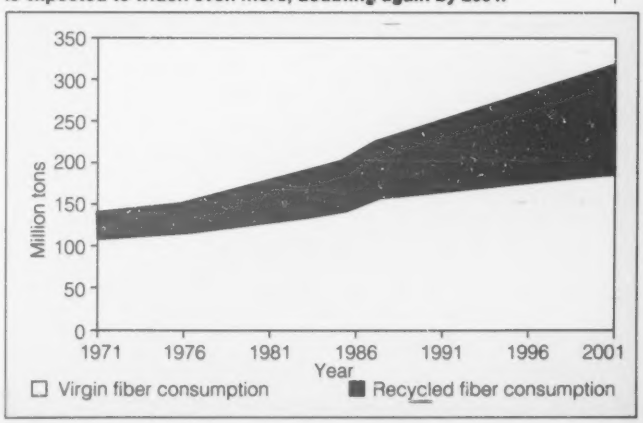
Current demand, however, has not been even across all countries. In Western Europe, the use of recycled fiber has grown nearly four times as fast as the demand for virgin fiber. By contrast, North American recycled fiber use has grown at only 3.4%/year, or slightly more than the increase in virgin fiber use for the same period. Clearly this would seem to indicate a significant potential to use more recycled fiber in North America.

By grade, the packaging board industry, particularly linerboard and fluting producers, has been and will continue to be the main user of recycled fiber. However, on a percentage basis, the most remarkable increases are expected in newsprint, printing and writing paper, and tissue products.

Growth in the importance of deinking grades will be one of the key trends in the wastepaper business. Currently, some 11 million tons, or approximately 14% of the recycled fiber used, are deinking grades. Approximately half of this is used for newsprint, with another quarter going to tissue products. Thus, the great bulk of wastepaper—64 million tons, or close to 85% of the total—is used without deinking, mainly in packaging grades. By 2001, the deinking grades are expected to have increased to about 31 million tons, or 24% of the total consumption of recycled fiber. In a strengthening of the past usage pattern, more than half of the deinked pulp will be used for newsprint.

A major improvement in the recovery rates of wastepaper will be necessary to meet the forecast demands for secondary fiber. An increase is expected in the recovery rates in virtually every area of the world (Table 1). The increases in Western and Eastern Europe will be particularly noteworthy. However, it is in North America, and particularly in the U.S., where the most dramatic

FIGURE 1: **Recycled fiber demand worldwide grew almost twice as fast as virgin fiber demand from 1971 to 1988, and that margin is expected to widen even more, doubling again by 2001.**



Mr. Veverka is president and CEO of Jaakko Pöyry Consulting Inc., Briarcliff Manor, N.Y. All figures, data, and results cited in this article are based on the multi-client study recently completed by Jaakko Pöyry Oy.

increases in wastepaper recovery will take place. In the case of the U.S., the recovery rate is forecast to go from 30.2% in 1988 to more than 44% just after 2000.

Recovery rates, however, are only part of the equation. Some areas of the world not only will use all of the wastepaper they recover but also must import secondary fiber to satisfy their total needs for raw materials. When considering the trade flows of recycled fiber, wastepaper utilization rates achieved by these areas of the world must be analyzed and compared with recovery rates.

Table 2 shows expected utilization rates. Countries where recovery rates (from Table 1) exceed utilization rates are net exporters of fiber. Countries with recovery below the utilization rates are net importers. Thus, Japan, with a recovery rate of 48% in 1988 and a utilization rate near 51%, is a net importer. North America is by far the largest source of wastepaper exports in the world, with an export surplus of 4.6 million tons in 1988, expected to increase to 10.8 million tons by 2001.

Wastepaper trade flows throughout the world show the importance of the U.S. as a major exporter of secondary fiber. The U.S. sends 3.18 million tons of wastepaper to Pacific Rim countries and 1.12 million tons to Central America. The recovery of wastepaper and board in North America is forecast to expand and continue to outstrip demand, allowing for a growing export surplus. A recovery rate increase from 29.4% to 42.9% for North America as a whole (Table 1), combined with a utilization rate increase of about 8.5% for the forecast period (22.8% to 31.3% in Table 2), allows for a doubling of offshore exports by 2001. The U.S. will be the most dominant source for all wastepaper, exporting between 4 million and 5 million tons to Canada, in addition to more than 10 million tons to offshore users.

TABLE 1: **To meet increasing demand for secondary fiber, wastepaper recovery rates are expected to increase in almost every area of the world, with North America experiencing the greatest percentage increase (13.5%) by 2001.**

Region	1988	%	2001
North America	29.4		42.9
U.S.	30.2		44.4
Western Europe	35.8		41.5
E.F.T.A. countries	40.9		47.8
European Community	35.1		40.7
Eastern Europe and U.S.S.R	29.0		38.7
Oceania	24.8		31.3
Latin America	33.6		36.8
Japan	48.0		52.0
China	20.4		24.5
Rest of Asia	34.2		40.9
Africa	16.5		19.0
World total	**32.7**		**41.0**

NEW DRIVING FORCES. The key driving force for the use of wastepaper has traditionally been economics. Wastepaper enabled mills and countries without abundant forest resources to compete effectively on bulk grades with integrated producers using virgin fiber. This was the case in large paper- and board-consuming regions, such as Japan and Western Europe, where it has been relatively easy to collect and process large volumes of wastepaper. In the Far East, it is doubtful if local industries could have progressed without the cost economies of wastepaper. In North America, on the other hand, abundant forest resources have not historically encouraged the use of recycled fiber.

Technology has also played a role in the traditional use of recycled fiber. Improved technologies in the fields of cleaning, deinking, and handling of wastepaper have allowed production of acceptable end products using secondary fiber as the raw material source.

This situation is now changing. There are new forces scarcely mentioned in previous times—problems associated with disposal of solid waste and the environmental factor. The paper industry is now being told to use wastepaper not because it is good for the paper industry but rather because it is good for the environment. The introduction of these considerations into the industry's thinking and growing reinforcement by mandatory legislative measures are creating strong pressures to recover and recycle more wastepaper in North America.

Despite the emergence of environmental forces for the use of wastepaper, economic reasons will continue to be important and, in many respects, a necessary ingredient for promoting recycled fiber use in the paper and board industry. Furthermore, technical developments in recycled fiber handling, such as fiber fractionation, bleaching, in addition to the other separate handling techniques, will, in the long-term, bring

TABLE 2: **A comparison of recovery rates (Table 1) with utilization rates shows North America could possibly double wastepaper exports by 2001.**

	Total paper and board production		Wastepaper consumption		Wastepaper utilization (%)	
	1988	2001	1988	2001	1988	2001
North America	86,737	115,198	19,778	36,030	22.8	31.3
Western Europe	57,633	78,844	19,811	31,228	34.4	39.6
E.F.T.A. countries	22,350	30,400	2,967	5,198	13.3	17.1
European Community	35,283	48,444	16,844	26,031	47.7	53.7
Eastern Europe	17,988	22,193	4,868	8,746	27.1	39.4
Oceania	2,487	3,864	702	1,271	28.2	32.9
Latin America	10,506	15,909	4,757	7,801	45.3	49.0
Japan	24,624	34,892	12,538	19,415	50.9	55.6
China	12,645	19,760	3,084	8,305	24.4	42.0
Rest of Asia	12,218	22,431	8,369	15,877	68.5	70.8
Africa	2,524	679	679	1,092	26.9	30.5
World total	**227,362**	**316,669**	**74,586**	**129,766**	**32.8**	**41.0**

additional economically feasible solutions to increased secondary fiber use.

COST COMPETITIVENESS. With these varied forces in mind, a change exists in the current economic situation for use of recycled vs virgin fiber for five specific grades—newsprint, printing and writing paper, tissue, linerboard, and corrugating medium. For comparison purposes, cost estimates were prepared for the production of the five products for various locations worldwide using both recycled and virgin fiber.

The basis for the cost estimates is a computerized cost-estimating model developed by Jaakko Pöyry. This model uses technical and economic mill data within a simulation framework and is typically used to examine the relative differences in production costs between existing pulp and paper mills. However, for this study, hypothetical new greenfield mills were simulated rather than using existing ones. This was done to present a more generic picture and to make the results as uniformly applicable as possible.

The new mills represent the most modern technology in typical mill/machine sizes for each of the paper and board grades examined. For technical and wastepaper procurement reasons, the average size of a mill using recycled fiber as the main raw material may be smaller than that of a virgin fiber-based mill. Costs are calculated for reels only, without regard to possible sheeting or converting operations. Capital costs, which have been included, represent a return on investment of 17%.

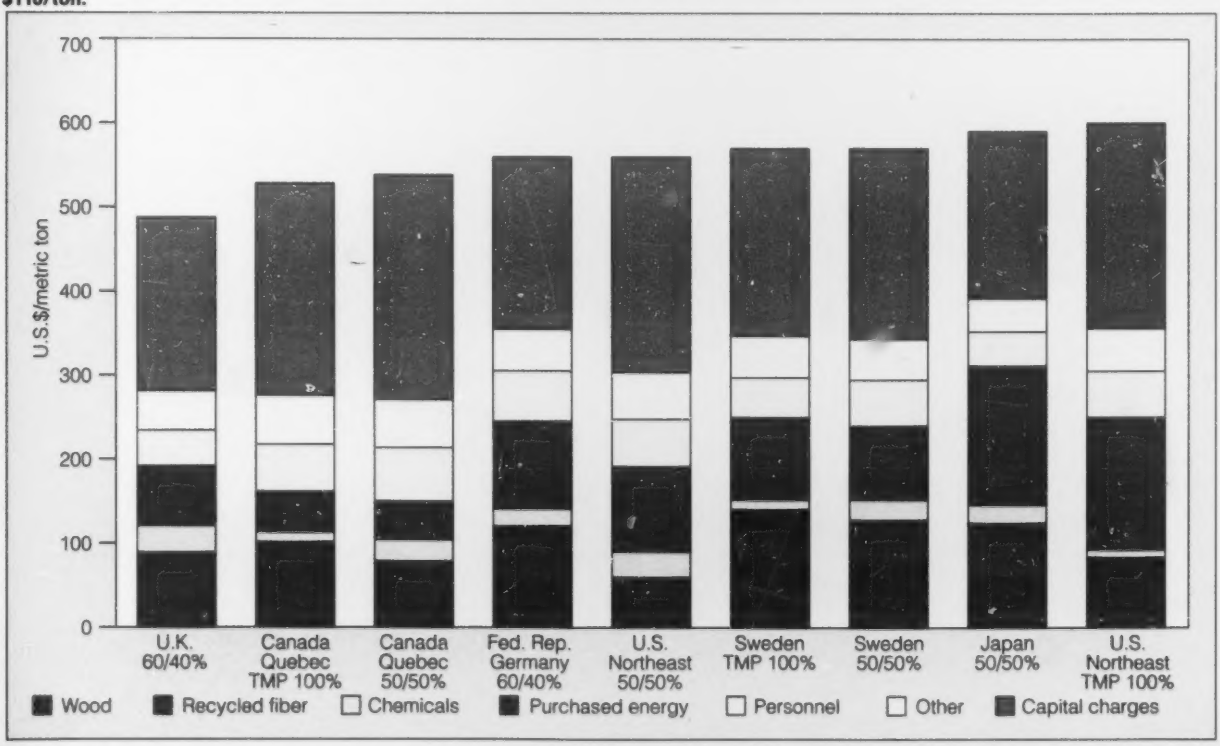
The unit prices and cost of raw materials, chemicals, energy, labor, and other production factors represent regional averages. Recycled fiber prices are average prices of the recycled fiber mix used in each grade. The cost level used for each recycled grade is that of third-quarter 1989. The units are U.S. dollars (US$)/metric ton. In the case of purchased chemical pulp, pulp substitutes, and high-grade deinking waste, long-term trend prices have been used instead of the actual third-quarter 1989 prices to get a more realistic picture of the cost competitiveness between virgin and recycled fiber-based products. Therefore, the price used for northern bleached softwood kraft (NBSK) pulp represents a long-term trend level of $650/metric ton.

For each of the cost-competitive comparisons, the specifications for the grade and mills are presented, followed by the production costs of the grade in question.

NEWSPRINT. Capacity of the simulated newsprint mill is the same for both recycled fiber or virgin fiber mills, at 220,000 metric tpy (Figure 2). The finished product is standard newsprint at a basis weight of 45 g/m². The furnish ranges from 100% thermomechanical pulp (TMP) to 100% deinked recycled fiber.

The recycled fiber component for newsprint was a mixture of highest-quality old newspapers (ONP) and sorted newspaper and magazine waste collected from households. Typically this mixed newspaper and magazine waste contains approximately 70% ONP and 30% magazines, pamphlets, inserts, and other advertising

FIGURE 2: **Production costs for new 220,000-metric-tpy newsprint mills, in selected areas and with typical fiber furnishes, show that recycled fiber use can be a competitive alternative to a 100% virgin fiber mill, especially in the northeastern U.S., where savings could be $110/ton.**



materials. The yield when processing the furnish into deinked pulp was assumed to be 86%.

Production cost estimates of new newsprint mills in selected regions, with typical fiber furnishes for the region, are shown in Figure 2. The most competitive regions are the U.K. and Quebec. In Canada, there is no advantage from use of a partial-recycled furnish because of the low wood cost and, in particular, the low power prices. In Sweden, a 100% TMP-based newsprint mill would be as competitive as a 50% recycled fiber-based operation since the high price of recycled fiber (approximately three times the northeastern U.S. price) and the somewhat higher personnel and capital requirements associated with two fiber lines effectively counterbalance the savings in wood and energy costs.

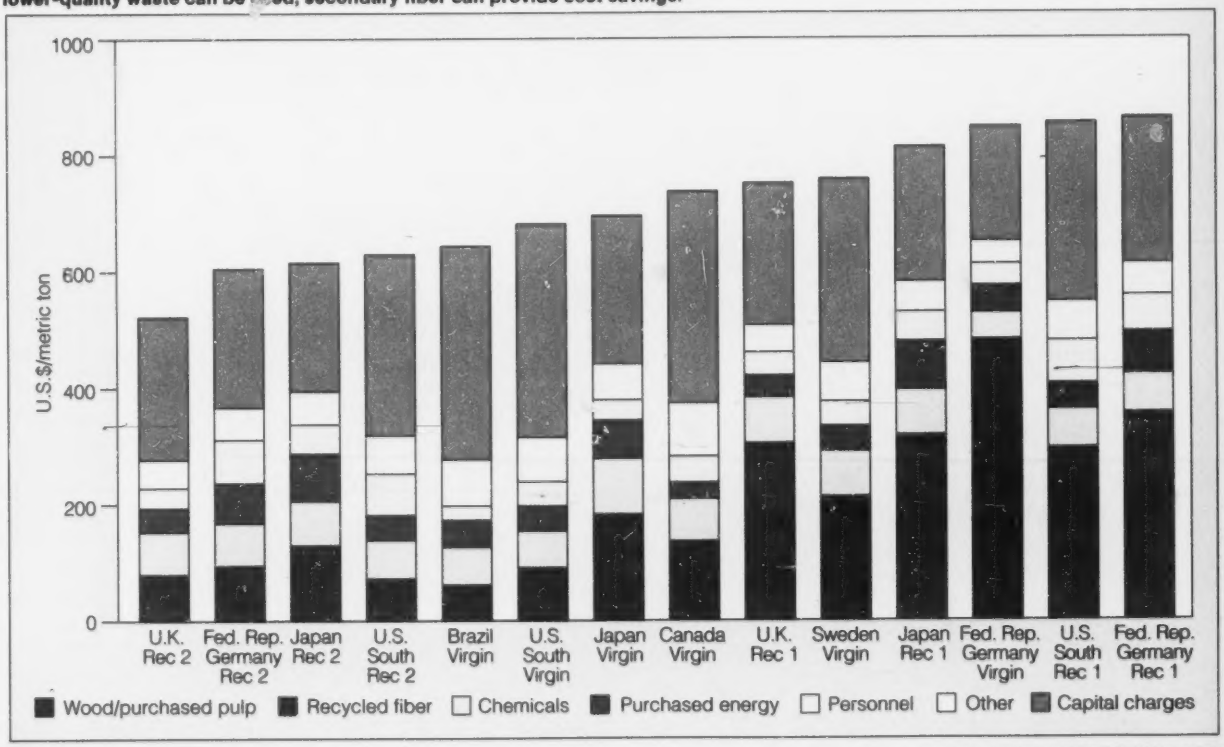
In general, the same problem of having two relatively small fiber lines instead of one line of economical size affects all 50:50 concept mills. Adding a second paper machine at the mill site would improve, to a considerable extent, the total mill economy of using a 50% recycled fiber furnish. Nevertheless, the savings in a northeastern U.S. mill (at a 50% recycled fiber content) are close to $50/ton.

Production of newsprint with a 100% recycled furnish would, however, look attractive in all regions studied. Savings in production costs range from $25/ton in Sweden to $110/ton in the northeastern U.S. It should be remembered that production of 100% recycled fiber-based newsprint requires procuring a very clean, homogeneous, and virgin fiber-containing newsprint stock on a continuous basis. With higher rates of utilization being forecast throughout the world, this may become increasingly difficult to do and could, in the long term, put a limit on the amount of recycled fiber used in a typical newsprint furnish.

PRINTING AND WRITING PAPER. For printing and writing grades, the production cost estimates were calculated assuming the finished product is a typical printing paper used by offices, namely an uncoated offset paper suitable for copy paper or computer printouts. Basis weights of these grades would typically be in the 60 to 80 g/m² range. For this grade, the capacities of the virgin fiber and recycled fiber-based mills would be considerably different. Capacity of the virgin fiber mill was taken to be 280,000 metric tpy, while the recycled fiber mill, due to the considerations originally mentioned, would typically be in the range of 150,000 metric tpy (Figure 3). The other major difference with this grade was the brightness, with the virgin fiber product being the brighter of the two (86% ISO vs 80% ISO).

An additional variable in the equation is that two types of recycled fiber were considered. The first was white ledger computer printouts and other printed wood-free waste. In the second case, a 50:50 mixture of magazines and ONP was used. The assumed deinked pulp yields varied between 86% and 82%. In addition to all of the above, the virgin fiber-based mill (except for Fed. Rep. Germany) was assumed to be integrated with a 400,000-metric-tpy kraft pulp mill.

FIGURE 3: **Comparison of production costs for a 280,000-metric-tpy virgin fiber mill and a 150,000-metric-tpy recycled mill show a mixed competitive picture. Mills using higher-grade wastes (Rec 1) generally have slightly higher costs than virgin fiber mills. However, if lower-quality waste can be used, secondary fiber can provide cost savings.**



The uncoated wood-free product presents a somewhat mixed cost-competitive picture (Figure 3). A printing paper mill using pulp substitutes and high-grade deinked wastepaper has no advantage in total raw material and energy costs compared with an integrated kraft mill. Actually, the raw material and energy costs for a southern U.S. mill are less than half those of a high-grade recycled paper mill. For total production costs (including capital costs), the virgin fiber-based mill has a cost advantage over a high-grade wood-free waste-based mill, amounting to some $170/ton in the southern U.S. and almost $115/ton in Japan. In Fed. Rep. Germany, the production costs of a nonintegrated virgin fiber-based mill and a recycled mill using high-grade waste are approximately at the same level.

If allowance is made for a lower product quality (including brightness), considerable cost savings can be achieved in all regions, if the lesser-quality recycled fiber furnish (blend 2) is used. Total production cost savings range from $235/ton in the case of the nonintegrated virgin fiber mills in Fed. Rep. Germany to about $70/ton in Japan and $55/ton in the southern U.S. (comparison is to integrated virgin fiber mills).

The lower-quality printing paper seems interesting in areas where the competitors are unintegrated producers—for example, the U.K. and Fed. Rep. Germany. However, it is, quality-wise, a totally different product. When using lower-quality raw material, the resulting product quality difference is reflected in the price structure of the products. This can clearly be seen in the price of recycled fiber-based continuous stationery, which is priced up to 30% to 40% lower than the virgin wood-free continuous stationery.

In most cases, the main advantage of the use of lower-quality waste has been the ability to offer the buyers a differentiated and less-expensive product, often with a clear gray shade for color. In addition, this has often been the only possibility for small unintegrated mills to continue operation since they are not competitive with the production of virgin fiber-based products.

TISSUE. For tissue production, a 70,000-metric-tpy machine was chosen as the representative mill size for both the recycled and virgin fiber-based products (Figure 4). The additional assumptions are that the virgin fiber mill would not be integrated with a chemical pulp mill and also that the purchased hardwood/purchased softwood mixture would be roughly 50:50.

The deinked pulp for the recycled fiber-based mill was based on a newspaper and magazine mix. While this may be typical for a European or Japanese mill, it is not necessarily a recycled fiber furnish favored by U.S. mills, where there is a tendency to use a somewhat higher grade of recycled fiber because of consumer desire for a higher-quality end product. The deinked pulp yield for the mixed newspaper/magazine input was assumed to be 80%.

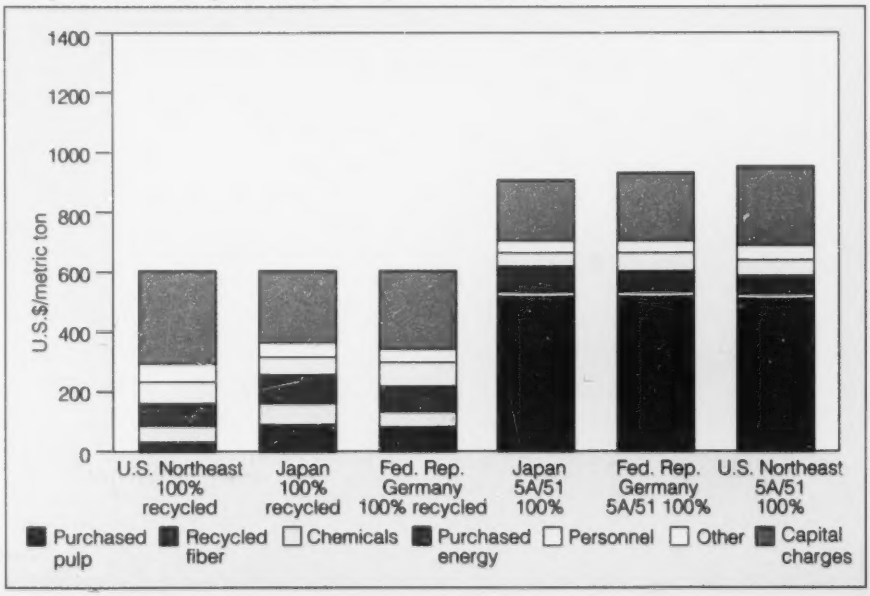
The product specifications chosen were that of a toweling grade produced in jumbo rolls. The cost of any conversion of the jumbo rolls to consumer-size rolls was not figured in.

A considerable cost savings is attainable due to the use of recycled fiber in this grade (Figure 4). The savings in raw material and energy costs are approximately $500/ton and total productions costs between $350 and $400/ton when pure virgin fiber and pure recycled-based products are compared. Although not shown on the diagram, estimates show that production based on the use of a 50:50 recycled fiber/virgin fiber mix would result in a savings of about $200/ton in total production costs.

Obviously, the cost comparisons can be affected greatly by the use of a higher-quality recycled fiber to improve end product quality or by the use of bleached chemi-thermomechanical pulp (BCTMP) in the place of chemical pulp. Nevertheless, the recycled fiber product consistently shows a production cost advantage over a virgin fiber-based tissue product.

It should be noted that despite lower production costs associated with the recycled product, this cannot automatically be translated to increased profit since prices of the finished product react substantially to quality levels. However, to date, the price differential between recy-

FIGURE 4: **Production comparison costs for a 70,000-metric-tpy tissue mill producing jumbo rolls show considerable savings are possible using secondary fiber—up to $400/ton when pure virgin fiber production is compared with pure recycled fiber production.**



cled fiber-based and virgin fiber-based jumbo reels has been somewhat smaller than the 35% difference in the production costs shown. Typically, this has been in the 15% to 25% range in Western Europe. Through environmental concern and product branding, it has been possible in many cases to set the prices of recycled fiber-based end products even nearer those of virgin fiber-based products. In some cases, the differential has been reduced to the 10% to 15% range.

LINERBOARD. For comparison of linerboard costs, the mill models differed in size between the virgin (kraft liner mills) and the recycled (test liner mills) (Figure 5). The typical kraft liner mill capacity was assumed to be 400,000 metric tpy, while the test liner facility was based on a 250,000-metric-tpy capacity. In both cases, production costs were calculated for a 150 g/m² product.

In principle, no technical reason exists for the recycled linerboard machine to be smaller than the kraft liner machine. In practice, however, recycled liner machines tend to be smaller for raw material procurement reasons, and the 250,000-metric-tpy machine size chosen is actually very large in comparison with existing test liner machines.

Two furnishes for kraft liner were investigated: a 100% unbleached kraft pulp and a mix of 80% unbleached kraft pulp and 20% old corrugated containers (OCC). Integration with an unbleached chemical pulp mill is assumed. For the test liner mill, the furnish chosen was 90% OCC and 10% double lined kraft (DLK) clippings. The average yield when processing corrugated waste to cleaned recycled pulp is assumed to be 92%.

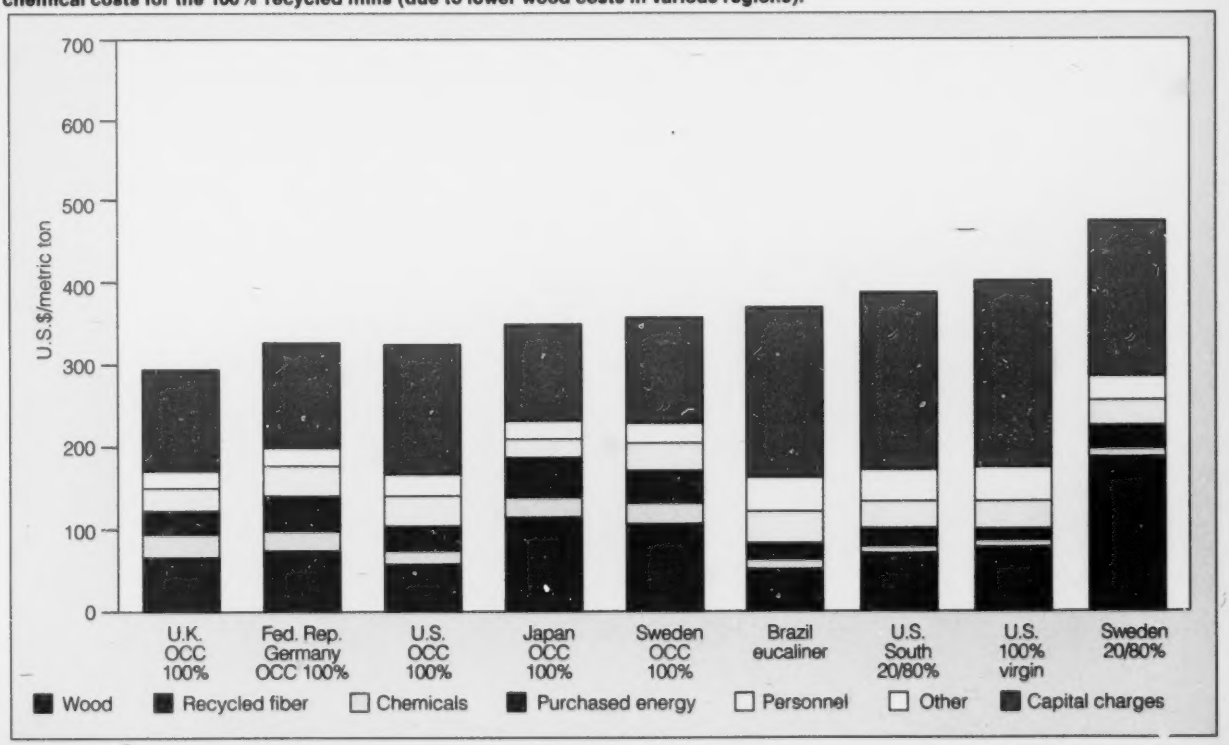
The cost comparative data in Figure 5 clearly show that the attainable savings in raw material and energy costs will vary with the recycled fiber content. In a case of 100% recycled linerboard, the energy costs are clearly higher because no energy-generating pulp mill is nearby. The chemical costs are likewise higher because of the surface sizing requirement of test liner.

In areas with high wood costs, such as Sweden, a test liner mill can have $75 to $80/ton savings in total raw material and energy costs over a kraft liner mill. However, in the southern U.S., where wood costs are low, only a minor advantage can be achieved with an increasing use of recycled fiber ($4/ton when using OCC and $5/ton when 100% OCC/DLK is used).

When total production costs are examined, the capital intensity of the virgin fiber mill, with its integrated pulp mill, clearly translates into a higher capital cost. Among virgin fiber-based producers, the southern U.S. and Brazilian (eucaliner) producers have a clear advantage. All the recycled fiber-based producers however, are competitive in their own local markets, including Japan.

According to calculations, in a new mill the production costs of test liner are about 13% to 27% lower than those of kraft liner in Western Europe. This also corresponds roughly to the price difference. In the southern U.S., the total cost difference is smaller due to lower wood costs and amounts to only about 15% to 20%.

FIGURE 5: **Comparison of production costs for a 400,000-metric-tpy kraft linerboard mill with a 250,000-metric-tpy test linerboard mill shows that the major cost difference is in capital costs for a virgin fiber mill (due to an integrated pulp mill) and raw materials and chemical costs for the 100% recycled mills (due to lower wood costs in various regions).**



CORRUGATING MEDIUM. For production of corrugating medium (fluting), the choice between virgin and recycled fiber is not a very important consideration in most areas of the world, except in the U.S., since this grade is already predominantly based on the use of recycled fiber. The typical mill size studied, at 250,000 metric tpy, was the same regardless of the fiber input (Figure 6). The basis weight of the product chosen for comparison was 150 g/m². In the case of the virgin fiber product, the furnish was assumed to be 100% NSSC pulp. For the recycled mill, the furnish was assumed to be 75% OCC and 25% mixed waste. Fiber yield on this furnish was assumed at 92%.

In fluting, the NSSC-based product can, in the southern U.S., reach similar or even slightly lower manufacturing costs than a waste-based product (Figure 6). However, this is possible only in the U.S., where wood prices are low. When considering the heavy capital cost of a new NSSC pulp mill, the cost comparison changes in favor of the recycled fiber-based product in the southern U.S. This advantage is approximately $50/ton. A northern U.S. location would be even more favorable for recycled fluting.

Given the relatively modest differences in production costs of recycled-based corrugated medium in various regions of the world, it is easy to understand why there is a relatively limited international trade in this product.

IMPLICATIONS TO BUSINESS. This cost-competitive analysis focused on the differences between new greenfield recycled fiber mills vs virgin fiber facilities. When considering the total spectrum of cost competitiveness, several other scenarios have to be considered:

- The cost implications of replacing an aging kraft mill at an integrated facility with a secondary fiber processing plant
- The potential of gaining incremental papermaking capacity and satisfying that increment with the use of recycled fiber.

Each of these alternatives would, given the proper circumstances, probably be very cost-competitive and cost-effective uses for recycled fiber. On the other hand, some conclusions relative to cost competitiveness and its impact on the increased use of recycled fiber can be made from the comparative study.

In newsprint production, using recycled fiber currently yields a definite cost advantage. In North America, this will probably mean that, in the long run, there will be a transition of newsprint production from areas having abundant wood resources toward areas having abundant recycled fiber resources.

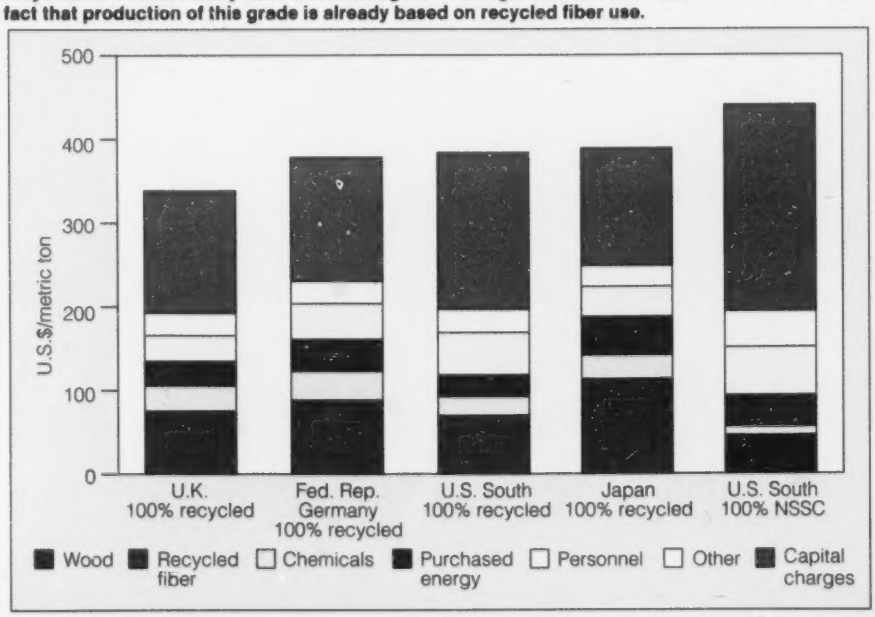
In printing and writing grades, there would appear to be minimal economic incentive for including recycled fiber in finished products. However, it is likely that recycled fiber-based products will be produced and sold, not because of any potential economic advantage but because of a public concern for the environment and a desire to purchase "environmentally friendly" products.

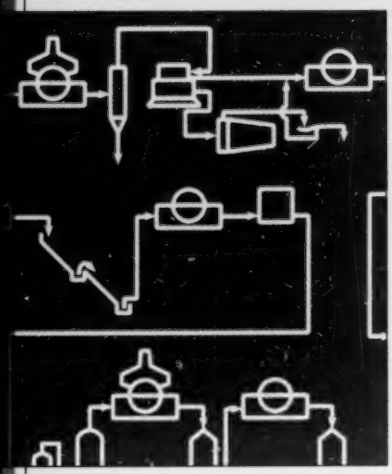
For tissue products, recycled fiber use can definitely lower the cost of production, but some quality differences exist in the products. Current indicators show that consumers in North America will be willing to accept slightly lower product quality and, hence, will favor recycled tissue products over virgin fiber-based products.

Linerboard production in the U.S. currently already contains, for the most part, a substantial recycled fiber quantity (20% OCC). The economics, though, would indicate that there is a potential for increasing the amount of recycled fiber used by existing mills and that there is also the possibility for producing an economically viable test liner mill. Despite apparent cost advantages, the increased use of recycled fiber in linerboard will probably depend on changes in applicable shipping rules, e.g., Rule 41.

For most of the world, no competitive activity exists between recycled fiber-based and virgin fiber-based corrugating medium. The clear economic advantage is toward the waste-based product. In North America, it is probably fair to say that the future should favor the introduction of more recycled fiber medium. However, in areas with low hardwood costs, NSSC medium can still be a very cost-competitive product. ■

FIGURE 6: **Production costs for a new 250,000-metric-tpy corrugating medium mill show that recycled fiber mills clearly have an advantage over a virgin-based NSSC mill, which mirrors the fact that production of this grade is already based on recycled fiber use.**





Proper Deinking Chemistry, Bleaching Technique Crucial to Pulp Brightness

Bleaching trials of deinked groundwood grades show that understanding residual ink's impact on brightness will help improve pulp quality

By MICHAEL DODSON and LOWELL DEAN

The U.S. paper industry has historically recycled about one-fourth of its total production, except during World War II. This rate is approximately half that of countries with limited natural resources, such as Great Britain, Holland, or Japan. The U.S. recycling rate peaked during the war years at 35% due to the need for conservation of raw materials. After the war, legislation was passed to stimulate the development of natural resources, which gave the production of finished goods from virgin materials a distinct economic advantage.

Although newspaper was recycled during the war, afterwards, until the mid-1970s, recycling back into newsprint was practiced by only one corporation, Garden State Paper. In the mid-70s, three mills in the U.S. began recycling newspaper because of wood supply limitations. Before that, most deinking was conducted with wood-free wastepaper, mainly for tissue production and to a lesser degree printing and writing paper.

Wood-free grades have become less available, forcing major wastepaper consumers to evaluate groundwood wastepaper grades. Also, over the next decade more high-quality mechanical fiber will be used in traditional wood-free grades, with the increased acceptance of bleached chemi-thermomechanical pulp (BCTMP). As the use of groundwood grades increases, so will the need for upgrading quality through bleaching technology.

Why should there be an interest in recycling groundwood grades? Table 1 lists the U.S. production of all grades of paper and paperboard. As the table shows, groundwood grades (newsprint, uncoated groundwood, coated groundwood) account for a significant portion of total paper production. In fact, the 11.7 million tons account for 31% of 1989's paper production and, if tissue is excluded (much being unrecyclable), these grades account for 36% of the total. When Canadian production is included, more than 20 million tpy could potentially be recycled in North America.

Mr. Dodson is southeast regional manager, and Mr. Dean is manager-chemical sales, Lion Industries, Vancouver, Wash.

WASTEPAPER QUALITY. A readily available supply of wastepaper is not enough. The resulting pulp must have adequate quality for its final end use at competitive manufacturing costs. The key pulp quality issues are strength at a reasonable drainage rate and good optical properties (brightness, opacity, and cleanliness). This article deals with the brightness quality spectrum that can be expected from peroxide and hydrosulfite bleaching of deinked groundwood content pulps.

Various key factors determine the brightness of deinked pulp. They include the following:

- Type of wastepaper
- Pulping/deinking chemistry
- Efficiency of ink removal by washing or flotation equipment
- Amount and efficiency of water clarification
- Bleaching method.

Meeting quality expectations requires good performance in all areas. Furthermore, since many of these factors are interrelated, there may be compromises between them. This places a great importance on field op-

TABLE 1: **Groundwood grades (newsprint, uncoated groundwood, coated groundwood) account for a significant portion of paper production, making those grades major candidates for recycling.**

	1989 annualized[1]
Newsprint	6,088
Uncoated groundwood	1,754
Coated groundwood	3,894
Coated free-sheet[2]	3,300
Uncoated free-sheet	11,043
Other printing/writing	1,494
Packaging and other paper	4,925
Tissue	5,036
Total paper	**38,133**
Total paperboard	**38,492**
Total paper and paperboard	**76,625**

1. American Paper Institute.
2. *Pulp & Paper* estimate.

timization of deinking chemistry, water clarification, and bleaching conditions.

The type and quality of the paper furnish is probably the major factor in determining ultimate brightness development of deinked pulps. The proper wastepaper grade should be selected based on the final product with respect to strength and optical property needs. Both the proper grade and the age and homogeneity of the furnish are important.

Lower-quality grades can contaminate wastepaper and must be avoided. Adherence to guidelines such as the paperstock standards and practices of the Paper Stock Institute of America are effective in minimizing contamination. Age of the wastepaper is also important, especially in groundwood grades, which are more susceptible to yellowing from light than wood-free grades. Even short periods (less than six months) of aging can result in the loss of one or two brightness points. Severe aging or yellowing from sunlight will result in even lower brightness and ink removal problems.

In general, newsprint brightness varies depending on the region where it was manufactured. West Coast newsprint produced from darker wood species is normally about 55 brightness, while southern newsprint is approximately 57 and eastern Canadian and northeastern U.S. newsprints are normally 59 and higher. Since newsprint sales tend to be regionalized, it can be anticipated that deinked pulp brightness will be dependent on the region in which the wastepaper is collected.

The majority of coated groundwood paper is No. 5 grade, although there is also production in the higher-quality No. 4 grade. Much of this production has low basis weight and is used in magazines. The basesheet brightness for No. 5 paper is typically 64 to 70 brightness depending on individual mill quality specifications, coating coverage, and coating brightness.

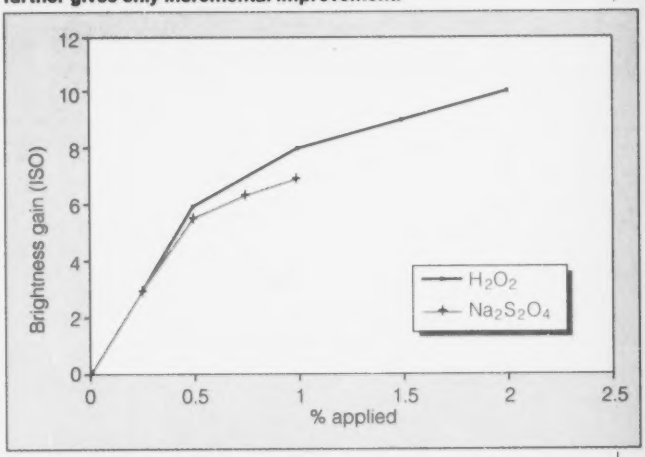
The uncoated groundwood grades have the widest range of brightness levels. Upgraded or specialty newsprint is on the low end of the spectrum at 61 to 65 brightness, while some supercalendered grades can be as high as 74 to 76 brightness. These grades are probably the most difficult to segregate as postconsumer waste since much ends up as inserts in newspapers.

BLEACHING OF DEINKED PULPS. Groundwood deinked and wood-free pulps are bleached by different chemicals. Traditionally, wood-free pulps have been bleached to 76 to 80 with chlorine-based oxidants. Single-stage hypochlorite bleaching is most common. Both CEH and CH bleach sequences are used when wastepaper quality is lower and brightness standards higher.

Delignifying bleaches, such as chlorine or hypochlorite, are not appropriate for groundwood due to the high loss in yield. Traditionally, sodium hydrosulfite and hydrogen peroxide have been used to bleach deinked groundwood pulps.

The following discussion endeavors to define the brightness development of deinked pulps made from

FIGURE 1: **Good brightness can be obtained through application of peroxide up to 1%. However, increasing the application level further gives only incremental improvement.**



100% newsprint, 60% newsprint/40% coated magazine, and 100% coated magazine. The information on 100% newsprint is a compilation of data accumulated during 16 years of bleaching of commercially generated deinked pulps. This is supplemented by recent work on a commercial pulp made from a 60% newsprint/40% magazine furnish and a lab pulp made by simulating a flotation/washing system from 100% magazine stock.

100% NEWSPRINT BLEACHING. Deinked pulps do not respond as well to bleaching as virgin pulps.[1] For instance, in peroxide bleaching of mechanical pulps, six to eight point increases can be expected from 1%, 12 to 15 points from 2%, and 17 to 18 points from 3%. These numbers can be contrasted with the curve in Figure 1. Good response is obtained with up to 1% peroxide applied. However, increasing the application level further gives only incremental improvement.

Residual ink and metal contamination critically affect the response. In fact, some deinked pulps with high metals and residual ink give only limited response—two to four point increases with 1% peroxide. High residual ink and metals can be the result of a system closure that is too tight, especially with respect to fines removal. The metals and ink have a tendency to travel with the fines, so it is important to establish the proper balance between yield and good bleach response in addition to using chelants for metal control.

Interestingly, hydrosulfite bleaching also seems to be affected by residual ink, although to a lesser degree than peroxide bleaching. This effect may be more a masking of residual ink than hydrosulfite decomposition from iron, although the variation in response is not well understood. In mill operations brightness response on 100% newsprint varies from five to eight point increases, with six to seven point increases being normal. When only a six or seven point increase is required, hydrosul-

TABLE 2: **Mechanical pulp in coated groundwood has a higher brightness than in newsprint, resulting in a significantly higher brightness vs 100% newsprint.**

	100% newsprint		60%/40%		100% coated	
	Brightness	Bleach response	Brightness	Bleach response	Brightness	Bleach response
Deinked pulp	47 to 50	—	54 to 56	—	62 to 67	—
Single-stage hydrosulfite[1]	53 to 57	6 to 7	60 to 63	6 to 7	68 to 74	6 to 8
Single-stage peroxide[2]	53 to 58	6 to 8	60 to 64	6 to 8	71 to 77	9 to 10
Two-stage peroxide/hydro[3]	57 to 62	10 to 12	63 to 67	9 to 11	74 to 80	12 to 13

1. 1.0% sodium hydrosulfite applied.
2. 1.0% hydrogen peroxide applied at high consistency.
3. 1.0% hydrogen peroxide/1.0% sodium hydrosulfite applied.

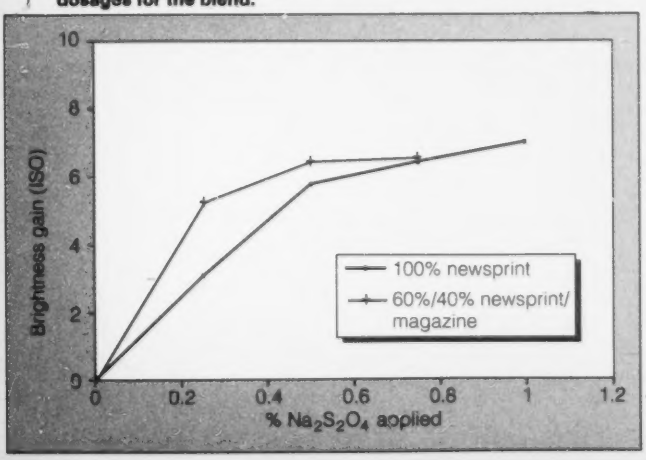
fite bleaching is preferred over peroxide due to its lower chemical and capital costs. Groundwood paper deinking is conducted at low temperatures, 110° F to 120° F. When hydrosulfite bleaching is installed, consideration should be given to heating the pulp to 135° F to 150° F because this should give one point higher brightness than lower temperatures.

For mills that require greater than a 55 to 57 brightness with a 100% newsprint furnish, serious consideration should be given to two-stage bleaching. The peroxide stage can be moderate or high consistency. High-consistency bleaching requires higher capital but has lower chemical costs.

60% NEWSPRINT/40% MAGAZINE BLEACHING. Until a year ago, two Canadian operations were the only mills in North America using a mix of newsprint and coated paper. Currently, there are two in operation in the U.S. and three new systems have been approved. The systems being installed are combination flotation/washing deinking plants. Thus, there is not much information on bleaching response of these pulps in U.S. and Canadian wastepaper furnishes.

Care must be used in drawing direct conclusions from European data. For example, their furnishes include not only newsprint and magazines but also printing and writing paper. There is little segregation of wood-free wastepaper for wood-free deinking as in North America, and this can affect the base brightness and bleachability.

FIGURE 2: **In bleaching of both 100% newsprint and a 60%/40% newsprint/magazine blend with hydrosulfite, similar responses were obtained, except that responses leveled off at lower dosages for the blend.**



As magazine is added to newsprint, pulp characteristics change in three ways. Strength properties increase since coated groundwood has a much higher kraft content. The mechanical pulp in a coated groundwood sheet has a higher brightness—typically 64 to 70—than in a newsprint sheet. This difference results in a significantly higher brightness (six to seven points) vs 100% newsprint (Table 2). Slightly higher brightness can be expected if either high-quality newsprint is used or if the newsprint is sourced from eastern Canada or the northeastern U.S.

As magazine addition is increased, ash content also increases. For good flotation performance, a minimum amount of ash is required. Unfortunately, ash can be detrimental to peroxide bleaching.[2] The ash carries high levels of metals, even to the degree that the effectiveness of a chelating agent can be overwhelmed. Thus, it is important to have adequate washing if peroxide bleaching is a part of the process.

A laboratory study was conducted on pulp produced in a combination deinking system with minimal washing. The ash content was high (about 9%). The purpose of the study was not only to check the response to peroxide bleaching but also to compare Lionsperse 855, a proprietary chelant, with DTPA. This initial study indicates that more severe conditions (longer retention, higher temperature) should be used than when bleaching pulp from 100% newsprint.

Using pulp of 53.6 initial brightness, a five-point increase was obtained with 1% peroxide by bleaching for two hours at 10% consistency. Another half-point increase was obtained using 1.5% peroxide. Improved results were obtained since 30% to 40% residual peroxide remained and high-consistency conditions were not used. Either 0.2% DTPA or Lionsperse 855 as a pretreatment gave similar results. With Lionsperse 855 as the chelant, 58.9 brightness was obtained with a peroxide residual of 32% vs 58.7 and 37% residual with DTPA.

A different sample from the same system was tested for hydrosulfite bleach response. Comparing 60%/40% blend with 100% newsprint produced similar bleach responses, except that the response leveled off at lower dosages for the blend (Figure 2). This difference could be explained by the lower amounts of mechanical fiber available for bleaching reactions in the blend. Single-stage hydrosulfite bleaching gives adequate brightness for standard newsprint and low brightness (low 60s) for

specialty grades. For higher-brightness grades, a two-stage bleach plant could be necessary.

100% COATED BLEACHING. Deinking of 100% coated wastepaper has the greatest potential for use in higher-brightness grades of paper, such as coated and uncoated groundwood, as well as tissue. Currently, only two mills in the U.S. use this furnish.

To round out this study, a sample of magazine stock was deinked in the Lion research laboratory. The paper was deinked using flotation followed by two wash stages with a 60 mesh screen. A typical deinking formulation was used with 0.1% Lionsperse 855, 1% sodium silicate, 0.5% H_2O_2, 0.5% Lionsurf FA-709, and 0.5% NaOH.

After deinking, the pulp with 62 brightness was used for subsequent peroxide bleaching. Chelant pretreatment on this pulp did not improve the bleach response, indicating that ash removal was effective with the laboratory washing techniques. However, this indication does not imply that chelants will not be necessary in a commercial installation where higher residual ink and ash levels can be expected than in lab pulps.

Bleaching with 1% peroxide for two hours at 10% consistency gave a 9.5% lift to 71.6 brightness. Using 1.5% peroxide resulted in an additional increase of 0.5 to one point. More severe bleaching conditions should be used on this pulp than on the 60%/40% blend. Even at a bleaching temperature of 150°F (vs 135°F for the 60%/40% blend), there was 46% residual peroxide with 1% applied and in excess of 50% residual with 1.5% applied. Further optimization (including longer retention and higher consistency) should improve the results of this study.

Lionsperse 855 was evaluated to determine the feasibility of reducing costs by partially replacing silicate in the peroxide bleach liquor. With 0.2% chelant, the silicate level could be reduced from 3% to 1% at an equal brightness of 71.6. The residual peroxide level was slightly lower without silicate, 48% vs 44%. At this replacement ratio, savings should be more than $1/ton.

Although hydrosulfite bleaching was not conducted on this sample, previous lab work and mill experiences indicate that a slightly better bleach response can be obtained with coated groundwood. This response may be the result of lower residual ink levels since magazines have a lower ink content initially than newspaper. Also, ink removal from coated paper is easier since the ink is on the coating and has not penetrated into the fiber.

The deinking and bleaching of 100% coated paper produces the highest-brightness pulp. This pulp could be used in higher-quality grades since a properly designed deinking and bleaching system could produce 74 to 80 brightness (Table 2). ■

REFERENCES

1. G. Galland, E. Bernard, and Y. Verac, "Achieving a deinked pulp with high brightness," *Paper Technology*, Dec. 1989, p. 28.
2. D. Ring, "Deinking of Coated Groundwood Papers Using Hydrogen Peroxide," PITA Symposium Proceedings. March 1990.

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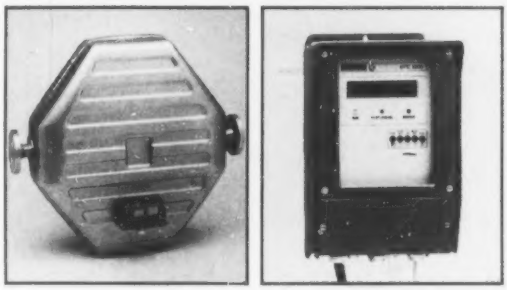

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